01-03-00

Docket No. 58434-A/JPW/SHS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Honorable Assistant Commissioner for Patents
Washington, D.C. 20231

December 29, 1999

S I R:

Transmitted herewith for filing are the specification and claims of the patent application of:

B. Jack Longley for
Inventor(s)

METHODS FOR INHIBITING CUTANEOUS INFLAMMATION AND HYPERPIGMENTATION
Title of Invention

Also enclosed are:

__X__ __9__ sheet(s) of ____informal __X__formal drawings.

__X__ Oath or declaration of Applicant(s). (unsigned)

__X__ A power of attorney (unsigned)

____ An assignment of the invention to _____

_____

__X__ A Preliminary Amendment

____ A verified statement to establish small entity status under 37 C.F.R. §1.9 and §1.27.

The filing fee is calculated as follows:

CLAIMS AS FILED, LESS ANY CLAIMS CANCELLED BY AMENDMENT

	NUMBER FILED		NUMBER EXTRA*		RATE SMALL ENTITY	RATE OTHER ENTITY		FEE SMALL ENTITY	FEE OTHER ENTITY
Total Claims	27 -20	=	7	X	$ 9.00	$18.00	=	$ 63.00	$ 0
Independent Claims	10 -3	=	7	X	$39.00	$78.00	=	$273.00	$ 0
Multiple Dependent Claims Presented: ____Yes __X__No					$130.00	$260.00	=	$ 0	$ 0
						BASIC FEE		$ 345	$ 690
						TOTAL FEE		$681.00	$ 0

*If the different in Col. 1 is less than zero, enter "0" in Col. 2

Applicants: B. Jack Longley
Serial No.: Not Yet Known
Filed: December 29, 1999

__X__ A check in the amount of $__681.00__ to cover the filing fee.

____ Please charge Deposit Account No. _____ in the amount of $_____.

__X__ The Commissioner is hereby authorized to charge any additional fees which may be required in connection with the following or credit any over-payment to Account No. 03-3125:

__X__ Filing fees under 37 C.F.R. §1.16.

__X__ Patent application processing fees under 37 C.F.R. §1.17.

____ The issue fee set in 37 C.F.R. §1.18 at or before mailing of the Notice of Allowance, pursuant to 37 C.F.R. §1.311(b).

__X__ Three copies of this sheet are enclosed.

____ A certified copy of previously filed foreign application No. _____ _____ filed in _____ on _____. Applicant(s) hereby claim priority based upon this aforementioned foreign application under 35 U.S.C. §119.

__X__ Other (identify) Express Mail Certificate of Mailing bearing label No. EM 262 551 295 US, dated December 29, 1999; 1 loose set of formal drawings

Respectfully submitted,

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Dkt. 58434-A/JPW/SHS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: B. Jack Longley

Serial No.: Not Yet Known (Continuation-in-part of U.S. Serial No. 09/306,143, filed May 6, 1999)

Filed : December 29, 1999

For : METHODS FOR INHIBITING CUTANEOUS INFLAMMATION AND HYPERPIGMENTATION

1185 Avenue of the Americas
New York, New York 10036
December 29, 1999

Assistant Commissioner for Patents
Washington, D.C. 20231
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SIR:

EXPRESS MAIL CERTIFICATE OF MAILING FOR ABOVE-IDENTIFIED APPLICATION

"Express Mail" mailing label number: EM 262 551 295 US
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I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. §1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents Box Patent Applications, Washington, D.C. 20231.

Printed Name: TINA ESCOA

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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SIR:

PRELIMINARY AMENDMENT

Please amend the subject application as follows:

In the claims:
Please cancel claims 10-11, 20-22, 27, 32 and 35-38 without prejudice to applicants' right to pursue the subject matter of these claims in a later-filed application. Please amend claims 12-19, 23-26, 28-31 and 33-34 under the provisions of 37 C.F.R. §1.121(b) by deleting the bracketed material and inserting the underlined material as follows.

--12. (Amended) The method of [any one of claims 1-9] claim 1, which comprises inhibiting the kinase enzymatic reaction of kit protein.--

--13. (Amended) The method of [any one of claims 1-9] claim 1, which comprises inhibiting chymase, elastase or other SCF cleaving enzymes.--

--14. (Amended) The method of [any one of claims 1-9] claim 1, which comprises inhibiting ligand binding

with an antibody, peptide, or nonpeptide chemical.--

--15. (Amended) The method of [any one of claims 1-9] claim 1, which comprises inhibiting kit dimerization with an antibody, peptide, or nonpeptide chemical.--

--16. (Amended) The method of [any one of claims 1-9] claim 1, wherein downstream signaling of the kit activation pathway is inhibited by blocking substrate association with kit kinase domain.--

--17. (Amended) The method of [any one of claims 1-9] claim 1, wherein downstream signaling of the kit activation pathway is inhibited by blocking enzymatic function in the downstream signaling pathway.--

--18. (Amended) The method of [any one of claims 1-9] claim 1, wherein downstream signaling of the kit activation pathway is inhibited by blocking binding of molecules in the downstream signaling pathway.--

--19. (Amended) The method of [any one of claims 1-9] claim 1, wherein the compound is an antibody or portion thereof.--

--23. (Amended) The method of claim [22] 19, wherein the [anti-kit] antibody is ACK2.--

--24. (Amended) The method of [any one of claims 1-9] claim 1, wherein the compound comprises a Fab

fragment of an anti-kit antibody.--

--25. (Amended) The method of [any one of claims 1-9] claim 1, wherein the compound comprises the variable domain of an anti-kit antibody.--

--26. (Amended) The method of [any one of claims 1-9] claim 1, wherein the compound comprises one or more CDR portions of an anti-kit antibody.--

--28. (Amended) The method of [any one of claims 1-9] claim 1, wherein the compound comprises a peptide, peptidomimetic, a nucleic acid, or an organic compound with a molecular weight less than 500 Daltons.--

--29. (Amended) The method of [any one of claims 1-9] claim 1, wherein the compound is sSCF, sKIT ligand or a fragment thereof.--

--30. (Amended) The method of [any one of claims 1-9] claim 1, wherein the compound is sKIT or a fragment thereof.--

--31. (Amended) The method of [any one of claims 1-9] claim 1, wherein the subject is a mammal.--

--33. (Amended) The method of [any one of claims 1-9] claim 1, wherein the administration is intralesional, intraperitoneal, intramuscular, subcutaneous, intravenous, liposome mediated delivery, transmucosal, intestinal, topical, nasal, oral, anal, ocular or otic delivery.

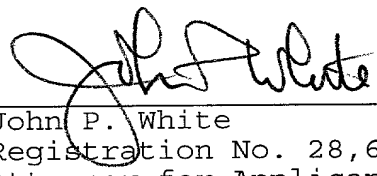
Remarks:

Claims 1-38 were pending in the subject application. Applicants have hereinabove canceled claims 10-11, 20-22, 27, 32 and 35-38 without prejudice to their right to pursue the subject matter of these claims in a later-filed application and amended claims 12-19, 23-26, 28-31 and 33-34. Claims 1-9, 12-19, 23-26, 28-31 and 33-34 involve no issue of new matter and entry of this amendment is respectfully requested.

If a telephone interview would be of assistance in advancing prosecution of the subject application, applicants' undersigned attorney invites the Examiner to telephone him at the number provided below.

No fee, in addition to the enclosed filing fee of $681.00, is deemed necessary in connection with the filing of this Preliminary Amendment. However, if any additional fee is required, authorization is hereby given to charge the amount of any such fee to Deposit Account No. 03-3125.

Respectfully submitted,



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Application
for
United States Letters Patent

To all whom it may concern:

Be it known that B. Jack Longley

have invented certain new and useful improvements in

METHODS FOR INHIBITING CUTANEOUS INFLAMMATION AND HYPERPIGMENTATION

of which the following is a full, clear and exact description.

METHODS FOR INHIBITING CUTANEOUS INFLAMMATION AND HYPERPIGMENTATION

This application is a continuation-in-part of U.S. Serial No. 09/306,143, filed May 6, 1999, the contents of which are hereby incorporated by reference into this application.

The invention described herein was made with Government support under grant numbers 1 R29 AR 40514-01A1, 5 P30 041942 and 1-RO1-AR43356-01A2 from the National Institutes of Health. Accordingly, the United States Government has certain rights in this invention.

Throughout this application, various publications are referenced by arabic numerals within parentheses. Disclosures of these publications in their entireties are hereby incorporated by reference into this application to more fully describe the state of the art to which this invention pertains. Full bibliographic citations for these references may be found immediately preceding the claims.

Background of the Invention

The use of murine models to investigate human cutaneous oncology, immunology and keratinocyte biology is advantageous over the use of human skin for obvious reasons. However, substantial differences exist between human skin and murine skin. In human skin, Stem Cell Factor is produced by epidermal keratinocytes after birth, unlike in normal murine skin. The result of this, among other things, is that melanocytes are present in the interadnexal epidermis in human skin. In contrast, melanocytes in adult murine skin are generally confined to hair follicles, with the exception of rare epidermal melanocytes found in the ears, footpads, and tail (1). A few dermal melanocytes may also be found in mice,

mostly in the ears. These differences have compromised the use of the mice as a model system for investigation of human cutaneous biology.

It has been discovered that melanocyte migration and development, as well as the survival of melanocytes and mast cells, are dependent on expression of the kit protein, a receptor tyrosine kinase encoded by the c-kit proto-oncogene (2-6). The ligand for kit, known as stem cell factor (SCF) (also called mast cell growth factor, steel factor, and kit ligand) may be produced locally in human skin by epidermal keratinocytes, fibroblasts, and endothelial cells (7-8). However, definitive studies of SCF production in murine skin have not been reported. Transgenic studies using the SCF gene promoter region and beta-galactosidase as a reporter gene suggest that, unlike in human skin, postnatal murine cutaneous SCF expression is limited to the dermis and hair follicles, and not found in epidermal keratinocytes (9). The difference in SCF expression between human and murine epidermis could explain the difference in melanocyte distribution and other biological phenomena in these two species.

SCF may be produced in two isoforms by alternate splicing of exon 6. One isoform lacks exon 6 encoded sequences and exists predominantly as a membrane-bound molecule. The other isoform contains exon 6 encoded sequences which include a protease sensitive site (10-19). Cleavage at the protease sensitive site causes the release of a soluble, bioactive form of SCF. The membrane-bound and soluble forms of SCF have differential effects on melanocyte precursor dispersal and survival (20) and exogenous soluble SCF may produce cutaneous mast cell hyperplasia and cutaneous hyperpigmentation (21-23). In addition, local high concentrations of soluble SCF have been found in lesions of human cutaneous mastocytosis, a

disease characterized by dermal accumulations of mast cells and increased epidermal melanin (7, 8, 24) and in spongiotic dermatitis, a common inflammatory condition of human skin (our unpublished data).

Summary of the Invention

This invention provides a method of preventing or treating in a subject contact dermatitis which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat contact dermatitis so as to thereby prevent or treat contact dermatitis in the subject.

This invention provides a method of preventing or treating in a subject hyperpigmentation which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat hyperpigmentation so as to thereby prevent or treat hyperpigmentation in the subject.

This invention provides a method of preventing or treating in a subject asthma which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat asthma so as to thereby prevent or treat asthma in the subject.

This invention provides a method of preventing or treating in a subject cutaneous inflammation which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat cutaneous inflammation so as to thereby prevent or treat cutaneous inflammation in the subject.

This invention provides a method of preventing or treating in a subject anaphylaxis and bronchospasm which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat anaphylaxis and bronchospasm so as to thereby prevent or treat anaphylaxis and bronchospasm in the subject.

This invention provides a method of preventing or treating in a subject mastocytosis which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat mastocytosis so as to thereby prevent or treat mastocytosis in the subject.

This invention provides a method of preventing or treating in a subject urticaria which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat urticaria so as to thereby prevent or treat urticaria in the subject.

This invention provides a method of preventing or treating in a subject hypersensitivity reactions which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat urticaria so as to thereby prevent or treat urticaria in the subject.

This invention provides a method of preventing or treating in a subject a tumor which expresses activated kit which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat a tumor which expresses activated kit so as to thereby prevent or treat a tumor which expresses activated kit in

the subject.

The invention provides a method of providing contraception to a subject which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent conception so as to thereby provide contraception to the subject.

Brief Description of the Figures

Figure 1:
Transgene design. Both transgenes used the human keratin 14 promoter and polyadenylation sequences. Transgene one included a rabbit b-globin intron, and transgene two included human growth hormone sequences to provide for stability. Neither the beta globin intron nor the human growth hormone sequences produce protein products.

Figure 2:
Increased mast cells in mice expressing epidermal membrane and soluble SCF (transgene one). (a) Numerous mast cells are demonstrated in the superficial dermis of body wall skin of newborn mice bearing transgene one (membrane/soluble SCF), using an immunoperoxidase/ alcian blue technique which stain mast cell granules metachromatically purple. Note the apposition of mast cells (arrowheads) to basilar keratinocytes, the source of SCF. Immunoperoxidase with an anti-S100 antibody in this preparation also demonstrates melanocytes as brown staining cells in the epidermal basilar layers of epidermis and follicles (white arrows). Sebocytes are seen as large, round, lightly S-100(+) cells in the follicular epithelium. Melanin pigment is stained black in this preparation. (b) Immunofluorescence with anti-kit antibodies highlights kit expressing dermal mast cells (arrowheads) in body wall skin of newborn (transgene one membrane/soluble SCF) mouse. (c) Anti-kit antibody immunofluorescence shows mast cells crowded in the papillary dermis and extending into the upper reticular dermis and body wall skin of 21 day old, transgene one positive mouse, MC, confluent mast cells; arrowheads, individual and small clusters of mast cells; E, epidermis; F, follicles; K, keratin layer. (d) Hematoxylin and eosin-stained sections show mast cells filling the superficial corium in section of tongue from

a 21 day old, transgene one positive mouse. The lack of abundant melanocytes and melanophages in this anatomic site allows easy visualization of the mast cells. This histologic picture is identical to that seen in human cutaneous mastocytosis. (e) Alcian blue stained serial section of tongue shows metachromatic granules in mast cells of 21 day old, transgene one positive mouse.

Figure 3:

Electron microscopy confirms the presence of melanocytes and mast cells in transgenic mice. (a) Transgene one mouse with membrane/soluble epidermal SCF has numerous dermal mast cells (arrowheads) as well as dermal melanocytes (arrows). Asterisks show the boundary of the dermis and hair follicle. Higher magnification images of mast cell and melanocyte are shown in b and c, respectively. Original magnifications: (a) 2,750, (b) 9,000, (c) 11,750.

Figure 4:

Transgenic phenotypes are stable across a wide range of gene expression levels. This figure compares the transgene copy number determined by PCR, with SCF mRNA expression as determined by RNAse protection assay, in lines from different founders. The relative density of SCF bands was determined by dividing the mean density of the SCF band by the density of a SCF band derived from an identical aliquot of RNA. Probe templates were 384 bases in length for SCF (40 base pairs of promoter sequence and 342 bases complimentary to nucleotides 814-1156 of murine SCF mRNA (5). A beta-actin probe was used as a control, and to allow standardization between RNA preparations from different mice. The beta-actin probe length was 310 bases, 227 bases of which are complementary to murine beta-actin mRNA. The probe was purchased from Ambion (pTR1-beta-actin-mouse anti-sense control template). Note the differences between TG2 (4x, 5x, 10x) and TG1

(6x).

Figure 5:
Epidermal SCF causes hyperpigmentation of murine skin. (a) Newborn mouse expressing membrane/ soluble SCF (transgene one, left) shows obvious hyperpigmentation compared to non-transgenic littermate (right). (b) Transgene two positive mouse overexpressing membrane-bound epidermal SCF shows a similar phenotype with generalized hyperpigmentation which is most discernible in the ventral and hairless areas, and which is maintained in adult life. Three week old transgenic (left) and non-transgenic littermate (right)

Figure 6:
Intraepidermal melanocytes are increased in transgenic mice. (a) Tail skin section from 21 day old mouse expressing epidermal membrane-bound SCF (transgene two) shows mild epidermal hyperplasia and a markedly increased number of melanocytes, identified as cells surrounded by clear halos, mostly at the dermal-epidermal junction. These mice also show extensive black epidermal melanin pigment (400x). (b) Note the lack of both basilar melanocytes and epidermal pigment in the skin of the transgene (-) littermate control mouse (C57 black 6 (400x)). (c) Epidermal melanocytes express kit protein. Immunofluorescence staining with anti-kit antibody and Texas Red labeled secondary antibody demonstrates confluent dendritic cells in the epidermal basalar layer of mice expressing membrane-bound SCF (transgene two arrows). These cells correspond to the S-100 protein (+) basilar dendritic cells seen in Figure 2a. Note two strongly kit positive solitary mast cells in the dermis (arrowheads, 400x). Light staining of dendritic melanocytes can also be seen in the epidermis of transgene one positive mice (please see figure 2b).

Figure 7:
Electron microscopy confirms the presence of epidermal melanocytes in both types of transgenic mice. (a) Electron microscopy shows numerous keratinocytes containing phagocytized melanin granules in the interadnexal epidermis of mice expressing membrane-bound epidermal SCF (3500x). b. Epidermal melanosomes, some marked with large arrows, are present in both keratinocytes and melanocytes. Pre melanosomes, marked with the open arrows, demonstrate the presence of a melanocyte. Note keratinocyte hemidesmosomes (small arrows) which confirm the location of the melanocyte within the epidermis (16, 320x).

Figure 8:
Allergic ear swelling is significantly increased in SCF transgenic animals, and is reduced by blocking the SCF receptor with the ACK2 monoclonal antibody. All transgenic mice show increased ear swelling in response to allergic contactants compared to non-transgenic animals ($p \leq 0.0001$), showing that SCF contributes to dermatitis. Similar results are seen with irritant contactants (data not shown). The ear swelling is specifically decreased by the ACK2 monoclonal antibody which blocks the SCF receptor ($p \leq 0.05$) confirming that epidermal SCF plays an active role in cutaneous inflammation.

Figure 9:
(a) An unpublished immunoperoxidase study of inflamed human skin with an anti-human SCF monoclonal anti-body shows soluble epidermal SCF in spongiotic (eczematous) dermatitis, here demonstrated in an epidermal spongiotic vesicle. Human spongiotic dermatitis may be associated with hyperpigmentation. Soluble epidermal SCF is not detected in normal skin with this technique (7), suggesting that epidermal SCF is released in cutaneous

inflammatory states. (b) Irritant dermatitis induced in transgenic mice by Croton oil is characterized histologically by spongiotic (eczematous) dermatitis. The murine dermatitis is shown in a hematoxylin and eosin stained slide because no satisfactory antibody against murine SCF is available to allow demonstration of soluble SCF by immunoperoxidases. However, these results combined with the ACK2 blocking studies shown above implicate epidermal SCF in this phenomenon.

Detailed Description of the Invention

This invention provides a method of preventing or treating in a subject contact dermatitis which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat contact dermatitis so as to thereby prevent or treat contact dermatitis in the subject.

This invention provides a method of preventing or treating in a subject hyperpigmentation which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat hyperpigmentation so as to thereby prevent or treat hyperpigmentation in the subject.

This invention also provides a method of preventing or treating spongiotic dermatitis which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat spongiotic dermatitis so as to thereby prevent or treat spongiotic dermatitis in the subject. As used herein, "spongiotic dermatitis" includes but is not limited to contact dermatitis.

This invention provides a method of preventing or treating in a subject asthma which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat asthma so as to thereby prevent or treat asthma in the subject.

This invention provides a method of preventing or treating in a subject cutaneous inflammation which

comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat cutaneous inflammation so as to thereby prevent or treat cutaneous inflammation in the subject.

This invention provides a method of preventing or treating in a subject anaphylaxis and bronchospasm which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat anaphylaxis and bronchospasm so as to thereby prevent or treat anaphylaxis and bronchospasm in the subject.

This invention provides a method of preventing or treating in a subject mastocytosis which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat mastocytosis so as to thereby prevent or treat mastocytosis in the subject.

This invention provides a method of preventing or treating in a subject urticaria which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat urticaria so as to thereby prevent or treat urticaria in the subject.

This invention provides a method of preventing or treating in a subject hypersensitivity reactions which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat hypersensitivity reactions so as to thereby prevent or treat hypersensitivity reactions in the subject.

This invention provides a method of preventing or treating in a subject a tumor which expresses activated kit which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat a tumor which expresses activated kit so as to thereby prevent or treat a tumor which expresses activated kit in the subject.

In one embodiment, the tumor is a mast cell tumor. In another embodiment, the tumor is a gastrointestinal stromal tumor. In another embodiment, the tumor is a germ cell tumor.

In one embodiment, the above method comprises inhibiting the kinase enzymatic reaction of kit protein.

In one embodiment, the above method comprises inhibiting chymase, elastase or other SCF cleaving enzymes.

In one embodiment, the above method comprises inhibiting ligand binding with an antibody, peptide, or nonpeptide chemical.

In one embodiment, the above method comprises inhibiting receptor dimerization with an antibody, peptide, or nonpeptide chemical.

In one embodiment of the above method, downstream signaling of the kit activation pathway is inhibited by blocking substrate association with the kit kinase domain.

In one embodiment of the above method, downstream signaling of the kit activation pathway is inhibited by blocking enzymatic function in the downstream signaling pathway.

In one embodiment of the above method, downstream signaling of the kit activation pathway is inhibited by blocking binding of molecules in the downstream signaling pathway.

In one embodiment of the above method, the compound is an antibody or portion thereof. In one embodiment, the antibody is a monoclonal antibody. In one embodiment, the monoclonal antibody is a human, humanized or a chimeric antibody. In one embodiment, the monoclonal antibody is an anti-kit antibody. In one embodiment, the anti-kit antibody is ACK2.

This invention provides the above method, wherein the compound comprises a Fab fragment of an anti-kit antibody.

This invention provides the above method, wherein the compound comprises the variable domain of an anti-kit antibody.

This invention provides the above method, wherein the compound comprises one or more CDR portions of an anti-kit antibody.

This invention provides the above method, wherein the antibody is selected from the group consisting of IgA, IgD, IgE, IgG and IgM.

This invention provides the above method, wherein the compound comprises a peptide, peptidomimetic, a nucleic acid, or an organic compound with a molecular weight less than 500 Daltons.

This invention provides the above method, wherein the compound is sSCF, sKIT ligand or a fragment thereof. As used herein "sSCF" can also mean "sKIT ligand."

This invention provides the above method, wherein the compound is sKIT or a fragment thereof.

This invention provides the above method, wherein the subject is a mammal. The subject of the above methods includes but is not limited to a mammal. The subject may be a mammal or non-mammal. The subject may be a human, a primate, an equine subject, an opine subject, an avian subject, a bovine subject, a porcine, a canine, a feline or a murine subject. In another embodiment, the subject is a vertebrate. In a preferred embodiment, the mammal is a human being.

This invention provides the above method, wherein the administration is intralesional, intraperitoneal, intramuscular, subcutaneous, intravenous, liposome mediated delivery, transmucosal, intestinal, topical, nasal, oral, anal, ocular or otic delivery.

This invention provides a method of providing contraception to a subject which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent conception so as to thereby provide contraception to the subject. In one embodiment, the subject is a male subject. In another embodiment, the subject is a female subject.

This invention provides the above method which comprises inhibiting the kinase enzymatic reaction of kit protein.

This invention provides the above method comprises inhibiting chymase, elastase or other SCF cleaving enzymes.

One skilled in the art can employ various methods for determining whether a compound inhibits the stem cell

signaling pathway. One of these methods comprises:

a) immobilizing kit protein on a solid matrix;

b) contacting the immobilized kit protein with the compound being tested and a predetermined amount of SCF under conditions permitting binding of kit protein and SCF in the absence of the compound;

c) removing any unbound compound and any unbound SCF;

d) measuring the amount of SCF which is bound to the immobilized kit protein;

e) comparing the amount measured in step (d) with the amount measured in the absence of the compound, a decrease in the amount of SCF bound to the kit protein in the presence of the compound indicating that the compound inhibits binding of SCF to kit protein, thereby indicating that the compound inhibits the stem cell factor signaling pathway.

Another method includes detecting in vitro phosphorylation of kit comprising the following steps:

1. Cells expressing KIT, either naturally occurring as in the C2, BR, P815, or HMC1 lines, or as the result of DNA transfection, are grown in vitro in the absence of exogenous SCF.

2. The cells are treated with the compound or substance. In the case of cells expressing wild type (non-mutated and not constuitively activated) KIT, treatment with the substance or compound may be followed by treatment with SCF. Controls include cells treated with compound or substance, and not exposed to SCF.

3. The cells are lysed and KIT is immunoprecipitated, electrophoresed, blotted with anti-phosphotyrosine antibody, and the

antibody detected by chemiluminescence or radioactive labeling and autoradiography, thereby determining the level of KIT phosphorlyation on tyrosine.

4. The level of KIT phosphorlyation on tyrosine in cells not exposed to the compound or substance is compared to KIT phosphorlyation on tyrosine in cells exposed to the compound or substance. A decrease in KIT phosphorlyation on tyrosine in the treated cells indicates that the compound or substance inhibits the SCF signaling pathway.

A cell proliferation and viability method comprises the following steps:

1. Cells expressing KIT, and depending on KIT activation for survival, are grown in the presence of SCF if they express wild type KIT or in the absence of SCF if they express mutated and constuitively activated KIT.
2. The cells are grown in replicate tissue culture wells, in the presence or absence of the compound or substance to be tested, and the number of viable and non-viable cells per well is determined daily by counting a sample of cells in a hemocytometer. The number of viable and non-viable cells are determined by the trypan blue exclusion method.
3. A decrease in cell growth, as determined by the presence of fewer viable cells in the wells treated with the compound or substance compared to the cells in the wells not so treated, indicates that the compound or substance interferes with the KIT SCF signaling pathway.
4. Alternatively, cell growth may be determined by measuring cellular incorporation of labeled

substances such as tritium labeled thymidine.

The present invention provides a method of identifying a composition, a compound or a procedure which can produce a skin response in a subject, comprising: a) administering said composition or compound, or applying said procedure to the transgenic mice which express endogenous epidermal stem cell factor, and b) analyzing the contacted skin for response.

In one embodiment of the method, the composition or compound can be administered orally or by injection.

In another embodiment of the method, the composition or compound can be administered topically by contacting the composition or compound with the skin of the transgenic mice.

In another embodiment of the method, the procedure is not previously known.

In another embodiment of the method, the procedure is identified by the method.

In another embodiment of the method, the procedure is DNA vaccination.

In this invention, the skin response may be induced. This skin response includes but is not limited to inflammation, tanning, melanoma, carcinoma or hyperpigmentation.

In another embodiment of the method, the composition may be cosmetics, medications or skin care products.

In another embodiment of the method, the composition or compound is not previously known.

In yet another embodiment of the method, the composition or compound is identified by the method.

In a further embodiment of the method, a mixture is produced for producing a skin response comprising an effective amount of the composition or compound identified by the method and a suitable carrier.

The present invention also provides a method of identifying a composition, a compound, or a procedure which can reduce or treat skin response in a subject, comprising: a) administering said composition or compound, or applying said procedure to the transgenic mice which express endogenous epidermal stem cell factor and which had been induced to produce a skin response and b) analyzing the skin of said transgenic mice to determine the reduction of skin response, wherein the reduction of skin response indicates that the composition, compound, or procedure can reduce skin response.

In one embodiment of the method, the composition or compound can be administered orally or by injection.

In another embodiment of the method, the composition or compound can be administered topically by contacting the composition or compound with the skin of the transgenic mice.

In another embodiment of the method, the procedure is not previously known.

In another embodiment of the method, the procedure is identified by the method.

In another embodiment of the method, the procedure is DNA vaccination.

In another embodiment of the method, the composition or compound is not previously known.

In another embodiment of the method, the composition or compound is identified by the method.

In another embodiment of the method, a mixture is produced for reducing skin response comprising an effective amount of the composition or compound identified by the method and a suitable carrier.

In another embodiment of the method, the skin response is inflammation, tanning, skin carcinoma, melanoma or hyperpigmentation.

In another embodiment of the method, the hyperpigmentation is natural occurring hyperpigmentation or post inflammatory hyperpigmentation.

In another embodiment of the method, the inflammation is associated with human hyperpigmentation, or human hypopigmentation.

In another embodiment of the method, the subject is a mouse or a human-being.

In another embodiment of the method, the epidermal stem cell factor transgene encodes either a membrane bound epidermal stem cell factor or a membrane/soluble epidermal stem cell factor.

In another embodiment of the method, the epidermal stem cell factor transgene encodes a membrane or soluble epidermal stem cell factor.

In another embodiment of the method, the epidermal stem cell factor transgene is cloned into a construct containing a human cytokeratin 14 promotor.

In another embodiment of the method, the human cytokeratin 14 promotor causes the expression of the stem cell factor transgene in murine skin of the basal layers of the interadnexal epidermis and the follicular epithelium.

In another embodiment of the method, the skin response of the transgenic mice can be induced by applying an irritant or an allergic dermatitis inducing agent to said skin.

In another embodiment of the method, the irritant is croton oil or dinitrofluorobenzene.

In another embodiment of the method, the croton oil or dinitrofluorobenzene are applied to the ear or the abdominal skin of the transgenic mice; wherein the abdominal skin is either hairless or shaved.

In another embodiment of the method, the croton oil is used at a concentration of 0.2 percent.

In another embodiment of the method, the dinitrofluorobenzene is used at a concentration of 0.5 percent in a 4:1 mixture of acetone and olive oil.

In another embodiment of the method, the reduction or treatment of hyperpigmentation is determined by electron microscopic analysis.

In another embodiment of the method, the compound is an epidermal stem cell factor inhibitor.

In yet another embodiment of the method, the stem cell factor inhibitor is a monoclonal antibody.

In a further embodiment of the method, the monoclonal antibody is ACK2.

The present invention further provides a method of identifying a composition, a compound or a procedure which can reduce radiation damage to the skin of a subject, comprising: a) administering said composition or compound, or applying said procedure to the transgenic mice which express endogenous epidermal stem cell factor, b) subjecting the skin of said transgenic mice and the skin of the control transgenic mice to radiation, and c) analyzing the effects of said composition, compound, or procedure on reducing skin radiation damages.

In one embodiment of the method, the composition or compound can be administered orally or by injection.

In another embodiment of the method, the composition or compound can be administered topically by contacting the composition or compound with the skin of the transgenic mice.

In another embodiment of the method, the procedure is not previously known.

In another embodiment of the method, the procedure is identified by the method.

In another embodiment of the method, the procedure is DNA vaccination.

In another embodiment of the method, the composition or compound is not previously known.

In another embodiment of the method, the composition or compound is identified by the method.

In another embodiment of the method, a mixture is produced for reducing skin radiation damages comprising an effective amount of the composition or compound identified by the method and a suitable carrier.

In yet another embodiment of the method, the radiation is ultra-violet light.

In a further embodiment of the method, the radiation damage is tanning, carcinogenesis, photo-aging, photo-damage or the development of melanoma.

The present invention also provides a pharmaceutical composition for treating human skin diseases, comprising (a) a compound that can treat skin diseases of the trangenic mice which express endogenous epidermal stem cell factor, and (b) a suitable carrier, wherein the compound specifically targets the epidermal stem cell factor or its receptor.

In one embodiment of the pharmaceutical composition, the compound is ACK2.

This invention will be better understood from the Experimental Details which follow. However, one skilled in the art will readily appreciate that the specific methods and results discussed are merely illustrative of the invention as described more fully in the claims which follow thereafter.

Experimental Details

Transgene construction:

Two murine SCF cDNAs were cloned into constructs containing the human cytokeratin 14 upstream region (27) (Figure 1). This promoter causes expression in the skin limited to the basal layers of the interadnexal epidermis and the follicular epithelium. The cDNAs were both full length clones, containing exon 6 encoded sequences. One cDNA (transgene one) was unmodified and therefore could produce a membrane-bound protein with the exon 6 encoded protease sensitive site, from which a soluble, bioactive form of SCF could be efficiently generated (10, 11, 28). The product of this transgene will be referred to as membrane/soluble SCF. The second cDNA (transgene two) had been previously modified by site directed mutagenesis, deleting the primary high efficiency cleavage site (between amino acids 164 and 165) and an alternate exon 7 encoded low efficiency cleavage site (found in murine SCF between amino acids 180 and 181). The SCF produced by this transgene therefore exists predominantly as a membrane-bound molecule (membrane SCF) (29). Both cDNAs have been previously shown to produce biologically active SCF (29, 30).

Generation and analysis of transgenic animals:

Two μg/ml transgenic DNA, in 10 mM Tris (pH 7.5), 0.1 mM EDTA was injected into fertilized oocytes collected from pseudopregnant mice as described (31). At birth, most transgene expressing mice could be identified by distinctive pigmentary phenotypes, as described in the Results section. Integration of transgenes was verified by polymerase chain reaction (PCR) of genomic DNA with transgene-specific primers and copy number estimated by Southern blotting of PCR products, followed by autoradiography and densitometry. Skin specific expression of transgene messenger RNA was confirmed by northern blotting and by reverse transcription-polymerase chain reaction with transgene specific primers using RNA

extracted from representative animals. Transgene expression was quantitated by RPA II Ribonuclease Protection Assay Kit (Ambion, Austin, TX, USA) according to the manufacturer's directions. Briefly, total RNA extracted from mouse skin was hybridized with digoxigenin labeled single stranded RNA probes for twenty three hours at 42^{0}C, digested with RNAse A and RNAse T1, electrophoresed through 5% polyacrylamide/7 Molar urea, protected fragments were transferred to Hy$^+$ membrane (Boerheringer-Mannheim, Indianapolis, IN, USA), bands detected by chemiluminescences, and band density determined by densitometry. Preliminary studies of RNA preparations from each transgenic line were performed to measure Beta-actin, and the amounts of RNA for SCF mRNA determinations adjusted for comparison. RNA was also used with reverse transcription and the polymerase chain reaction for direct amplimer sequencing of c-kit mRNA sequences in regions which could contain known activating mutations, as previously described (25). The primers used were 5' CAAATC/GCATCCC/TCACACCCTGTTCAC and 5' CCATAAGCAGTTGCCTCAAC which bind to nucleotides 1568→1593 and 1854→1835 and 5' TGTATTCACAGAGACTTGGC and 5' AAAATCCCATAGGACCAGAC binding to nucleotides 2384→2403 and 2595→2576. These regions contain the codons with both of the activating mutations, codon 559 and codon 814, respectively which have been described in human mastocytosis and in a murine mast cell line (5, 26).

Transgene one, containing the full-length unmodified SCF cDNA (membrane/soluble SCF), was injected into 100 F1 oocytes (C57 BL6 x SLJ), which were implanted into six host mothers, resulting in four independent hyperpigmented mice, all of which were positive for the transgene, and 40 other littermates which were pigmentary phenotype negative and transgene negative by PCR.

Oocytes for transgene two (membrane SCF) were F1

(C57BL/6J female x SLJ/J male), and the offspring could be black, agouti, or white. Injection of 40 embryos and implantation into six host mothers generated 48 pups, 21 of which were positive for integration by PCR. Of the 25 founder mice identified by PCR with the transgene specific primers, 3 were black, 13 were agouti, and 9 were white. Five PCR positive mice (3 agouti and 2 black) showed a clearly identifiable pigmentary phenotype. Given the inability of white mice to produce normal cutaneous pigment, it is possible that there were also white founders that expressed the transgene without the production of an obvious change in pigment. Backcrossing of phenotype positive, black and agouti founders to C57 BL/6 mice produced uniform pigmentary changes, described in the Results section.

Histology, immunohistochemistry, and electron microscopy: Tissues from transgenic and littermate mice were fixed in formalin and embedded in paraffin or polyester wax, sectioned, and stained with hematoxylin and eosin, azure blue, alcian blue, or Giemsa's stain according to standard techniques (31-33). Immunofluorescence studies were performed on polyester wax embedded sections or frozen sections, also using standard techniques. Antibodies included anti-S100 (rabbit anti-cow S100, pre-diluted, Dako, Carpinteria, CA), and the ACK2 and ACK4 monoclonals (rat anti-mouse c-kit (34), at 20 μg/ml). Controls included omission of the primary antibody or the use of isotype matched monoclonal antibodies of irrelevant specificity. Electron microscopy was done as previously described (35).

Inflammation Inducement and Treatment

We used Croton Oil and dinitrofluorobenzene (DNFB), respectively to reduce irritant and allergic contact dermatitis, respectively, in HK14-SCF transgenic mice and their non-transgenic liter-mates. Croton Oil was applied

directly to the ears of mice and DNFB was applied to the ears of mice after sensitization on shaved abdominal skin. Ear swelling was measured with a micrometer. In the ear-swelling test, the transgenic mice were divided into two groups; one group was treated with the murine monoclonal antibody ACK2, which blocks the interaction of SCF with its receptor (KIT), and the other group was treated with only saline. In addition, shaved abdominal skin of some mice was also treated with Croton Oil or with DNFB, and observed for inflammation and hyperpigmentation.

For statistical analysis, we used a mixed effects model, which allows us to fit repeated measurements over time and to compare different groups over time. We also performed orthogonal contrasts to evaluate the difference between treated and control groups at each time point. Immunoperoxidase study, using anti human SCF monoclonal antibodies, were performed in skin by standard method (7).

Experimental Results

Dermal mast cells accumulate in the presence of membrane/soluble keratinocyte SCF. Sections of skin from all mice producing membrane/soluble SCF (transgene one) showed increased mast cells in the dermis (Figure 2). In newborn transgene one positive mice, the mast cells were superficial near the dermal-epidermal junction, close to the epidermal source of soluble SCF (Figure 2a). In older mice the mast cells filled the papillary dermis in some areas, but were also present in the reticular dermis, in a pattern identical to that of human mastocytosis (Figure 2, b-d). Electron microscopic analysis confirmed the presence of numerous mast cells with characteristic granules within the dermis of the transgene one positive animals, and also showed that some of the heavily pigmented cells within the dermis of

transgene one positive mice were melanocytes (Figure 3). Mast cells were relatively rare and dermal melanocytes were not detected in the body wall skin of non-transgenic littermates and in transgene two positive animals of equivalent age. These observations were true across a wide range of copy numbers and levels of SCF mRNA expression (Figure 4). Since the keratin 14 promoter is properly expressed in the skin only by keratinocytes, and since the production of only membrane-bound keratinocyte SCF did not spontaneously result in increased dermal mast cells in transgene two positive animals, keratinocyte production of the soluble form of SCF appears to be able to cause cutaneous mastocytosis in mice.

SCF transgenic mice are hyperpigmented:

Targeted expression of each of the SCF transgenes in murine skin caused a similar, distinctive pigmented phenotype. The pigment responsible for the coat color of normal mice resides in the hair follicles and hair shafts, not in the epidermis. The transgenic mice, however, developed prominent epidermal pigmentation (Figure 5). Transgene positive animals could be identified by increased pigment at birth. By approximately 21 days of age, the phenotypes were well established; phenotype positive animals showed pigmentation of most of the skin as well as increased pigmentation of most of their skin as well as coat pigment. Extensive pigmentation was noted in a number of areas including the nose, mouth, ears, paws, and external genitalia when compared to normal littermate controls. There was enough individual variation in pigmentation so that no clear correlation between the level of pigmentation and the levels of transgenic expression could be shown. All transgenic animals showed similar degrees of pigmentation regardless of transgene type, copy number, or levels of SCF mRNA expression. In addition to the epidermal pigmentation, the three

transgene two positive agouti founders showed thin black transverse strips, consistent with the pigment distribution of the allophenic mice described by Beatrice Mintz (pictures not shown) (36).

Numerous melanocytes are maintained in the skin of transgenic mice:

The increased pigmentation of the skin of the transgene positive mice of both types is attributable to the presence of intraepidermal melanocytes, and to the epidermal melanin produced by those cells. Intraepidermal melanocytes can be identified in hematoxylin and eosin stained sections as cells in the basilar layers surrounded by clear halos (Figure 6, a & b) or in immunoperoxidase preparations by their expression of S-100 protein. Immunohistochemical analysis of animals expressing each of the transgenes showed numerous S-100(+) intraepidermal melanocytes (please also see Figure 2a). These melanocytes can be differentiated from Langerhans cells, which also express S-100 protein, because melanocytes are in the basal layers and Langerhans are in the suprabasal layers. Melanocytes can also be differentiated from Langerhans cells by their expression of the kit protein, the receptor for SCF, which is not expressed by Langerhans cells. Staining of transgenic animal skin with anti-kit antibody identified well-developed dendritic cells within the basilar layers of the epidermis and follicular epithelium, consistent with melanocytes (Figure 6c and 2b).

Histologic examination confirmed the presence of pigment within the epidermis of both transgene one and transgene two phenotype positive mice from all sites examined, including the ears, tail, footpads, and body wall (Figure 6a). In addition, transgene one positive mice showed many pigmented cells within the dermis. Pigmentary

abnormalities were not observed in transgene negative littermates. Only slight epidermal pigment was identified in these control mice, and mostly in non-hair bearing areas like the footpad and tail. Although pigment patterns were stable throughout much of the adult life of the mice, an occasional TG1 (msSCF) mouse developed patchy areas of depigmentation, mostly in the ears, associated with loss of epidermal melanocytes and increased pigment incontinence. This phenomenon was not observed in the mSCF mice.

Electron microscopy confirmed the presence of numerous melanocytes within the epidermis of both types of transgenic mice (Figure 7). Pigmented keratinocytes, similar to those seen in the epidermis of humans, were also present in the interadnexal epidermis of the transgenic mice. Intraepidermal melanocytes and pigmented keratinocytes were extremely rare in control mice.

<u>All transgenic mice showed ear swelling which was greater in magnitude and more prolonged than the non-transgenic (B6) control mice:</u>

Blocking SCF by administration of ACK2 decreased the magnitude of ear swelling in transgenic mice, as shown in the following figure 8.

<u>Averaging across time:</u>

There is a difference between the ACK2 treated and the control saline treated transgenic mice, which is significant at the 0.05 level. Averaging across time, there is also a significant difference between each of the two groups of transgenic mice (ACK2 treated and control) and the non-transgenic mice. Both comparisons are statistically significant at the 0.0001 level. See Figure 8. Observation of the abdominal wall skin treated with Croton Oil or DNFB showed hyperpigmentation and

thickening which was not observed in non-transgenic mice control (B6) mice that were treated identically. Histologically, hyperpigmentation correlated with dermal melanophages and increased epidermal melanin, identical to the changes seen in human postinflammatory hyperpigmentation.

Discussion

Melanocytes are maintained in human epidermis throughout life. In normal mice DOPA reaction positive cells (melanoblasts and melanocytes) are found in the epidermis at birth, but their number decreases from postnatal day 4 and is severely reduced after one month of age (37). One possible explanation for the maintenance of epidermal melanocytes in human skin, and the difference between the distribution of melanocytes in adult human and murine skin, could be expression of epidermal SCF. Human epidermal keratinocytes produce SCF (7, 8, 39), but the SCF gene does not appear to be expressed in murine epidermis (9). The results presented here show that SCF expression by murine epidermal keratinocytes causes the maintenance and stimulation of epidermal melanocytes throughout life. These data support the hypothesis that the decrease in melanocyte numbers in the postnatal mouse epidermis is due to a lack of local SCF expression. In combination with the fact that the soluble SCF produced by Sl/Sld mice is insufficient to support normal melanocyte survival and the observations that membrane-bound SCF promotes longer lasting kit activation and increased survival of kit dependent cells in the hematopoietic system (40,41), our data suggest that it is specifically the membrane-bound form of SCF that is crucial for melanocyte survival and function.

It is interesting to note that none of the animals expressing either of the transgenes described in this paper have developed melanoma to date, a finding which

supports previous observations that stimulation of the kit tyrosine kinase receptor does not appear to promote the development of melanocytic tumors (40). It also seems likely that the animals described herein, or animals derived from them, will be useful in the study of cutaneous mastocytosis and epidermal melanocyte biology.

The fact that SCF transgenic mice have greater responses to allergic and irritant contactants shows that epidermal SCF can actively contribute to eczematous dermatitis. This interpretation is confirmed by our demonstration that the inflammation can be diminished by blocking the SCF receptor with the ACK2 monoclonal antibody. Since human post natal epidermal keratinocytes express SCF, unlike post natal murine epidermal keratinocytes, and alterations of human epidermal SCF are found in spongiotic dermatitis (a form of eczema), these observations also support our contention that the skin of mice expressing epidermal SCF is a better model of human skin than is the skin of normal mice. Further supporting this claim is our previous observation of increased soluble epidermal SCF in the hyperpigmented lesions of mastocytosis. In sum, these data support our claim that animals expressing epidermal SCF are more suitable for a wide variety of investigations than those which do not.

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SECOND SERIES

Mastocytosis is a neoplastic disease caused at least in part by somatic mutations of the *c-KIT* proto-oncogene resulting in constitutive activation of its protein product, KIT, the receptor tyrosine kinase for stem cell factor. KIT stimulates mast cell proliferation and prevents apoptosis of neoplastic mast cells. Human gastrointestinal stromal tumor cells also express mutated and activated kit (Hirota et al 1998). To develop potential therapies for mastocytosis and gastrointestinal stromal tumor cells we used indolinones, small molecules which inhibit tyrosine kinases.

The proto-oncogene *c-KIT* encodes KIT (Yarden *et al*, 1987; Qiu *et al*, 1988), the receptor tyrosine kinase for stem cell factor (Martin *et al*, 1990), also known as mast cell growth factor. Somatic *c-KIT* mutations causing ligand-independent activation of KIT and cell transformation (Furitsu *et al*, 1993; Kitayama *et al*, 1995; Tsujimura *et al*, 1996; Hirota *et al*, 1998; Ma *et al*, 1999a) appear causal in certain types of mastocytosis (Nagata *et al*, 1995; Longley *et al*, 1996, 1999; Ma *et al*, 1999a).

Documented activating *c-KIT* mutations fall into two groups. One group consists of mutations in codon 816 of human *c-KIT*, or its equivalent positions in other species, resulting in single residue substitution for Asp816 in the activation loop of the receptor kinase domain (Ma *et al*, 1999a). The other group of activating mutations includes single residue substitutions and in-frame insertions or deletions in the receptor intracellular juxtamembrane region, which disrupt intramolecular inhibition of the kinase by a putative juxtamembrane α-helix (Ma *et al*, 1999b). All sporadic

adult-onset mastocytosis patients examined to date, and a subset of pediatric cases with atypical clinical presentations, have activating codon 816 mutations (Longley *et al*, 1999), whereas activating juxtamembrane mutations are common in canine mastocytomas (Ma *et al*, 1999a) and in human gastrointestinal stromal tumors (Hirota *et al*, 1998).

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Third Series of Experiments

Passive Anaphylaxis: SCF and KIT stimulation have a number of effects on mast cells in vitro, but it is not clear what the overall of effects of blocking KIT would be on inflammation and physiology in vivo. For instance, numerous studies have shown that recombinant SCF causes mast cell activation, directly stimulates mediator release, and alters the threshold for IgE dependent mediator release in vitro (Nakajima et al. Biochem. Biophys. Res. Commun. 1992) (Coleman et al. J. Immunol. 1993) (Columbo et al. 1992) (Bischoff et al. J. Exp. Med. 1992). Furthermore, a single injection of recombinant SCF causes mast cell activation in mice (Werschil et al. J. Exp. Med. 1992). However, daily administration of recombinant SCF to mice results in mast cell hyperplasia which varies at different anatomic sites, but does not result in mast cell activation (Anado et al. J. Clin. Invest. 1993), and the chronic administration of recombinant SCF to mice has variable effects on passive anaphylaxis reactions. Chronic stimulation with recombinant SCF followed by elicitation of passive anaphylaxis results in increased mast cell activation at some anatomic sites but not others and, surprisingly, a decrease in deaths in mice (Anado et al. J. Clin. Invest. 1993). This last result is counter-intuitive and indicates that exact effects of blocking KIT activation in vivo cannot be predicted accurately based on in vitro data. The authors themselves describe the results as unexpected.

To investigate the effects of blocking KIT in vivo, the ACK2 KIT-blocking-antibody and passive cutaneous anaphylaxis were used in the following experiments:

The skin of Balb/c mice was sensitized by an intradermal injection of murine monoclonal IgE specific for dinitrophenyl hapten. A second set of mice was sensitized with both the IgE and ACK2. 24 hours later, dinitrophenylated human serum albumin was injected into the tail veins of the mice in a mixture of 1% Evans' Blue dye (1 mg). Mice were observed for anaphylaxis, and thirty minutes later were sacrificed. The dorsal skin at the area of sensitization was removed for measurement of the amount of extravasated dye. The amount of dye was determined colorometrically after extraction of the skin in 1 ml of 1 Normal KOH overnight, at 37 degrees centigrade. 0.6 Normal phosphoric acid in acetone (15:13) was added and the mixture cleared by centrifugation. The absorbent intensity (OD) of the supernatant was measured at 620nm spectrophotometrically. The amount of extravasated dye, which is a measure of anaphylaxis, was significantly reduced in the presence of ACK2 (mean OD 0.0223) when compared to animals sensitized without ACK2 (OD 0.0617) a difference which was significant with $p < 0.01$, and the animals treated with ACK2 showed less respiratory distress compared to animals without ACK2.

These data demonstrate, for the first time, that blocking the SCF-KIT signaling pathway in vivo can decrease anaphylaxis and bronchospasms. Combined with the data on cutaneous inflammation, they demonstrate that the SCF-KIT pathway is actively involved in inflammatory reactions in vivo, rather than playing merely a supportive role in the development and maintenance of KIT expressing cells. This critical finding shows that acute blockage of the SCF-KIT signaling pathway can inhibit inflammation.

References for Third Series of Experiments:

1. Nakajima K, Hirai K, Yamaguchi M, Takaishi T, Ohta K, Morita Y, Ito K. Biochem. Biophys. Res. Commun.

1992, 183:1076-83.

2. Coleman JW, Holliday MR, Kimber I, Zsebo KM and Galli SJ. J. Immunol. 1993, 150: 556-62.

3. Columbo M , Horowitz EM, Botana LM, MacGlashan DW Jr., Bochner BS, Gillis S, Zsebo KM, Galli SJ, Lichtenstein LM. J. Immunol. 1992, 149:599-608.

4. Bischoff SC and Dahinden CA. J. Exp. Med. 1992, 175:237-44.

5. Wershil BK, Tsai M, Geissler EN, Zsebo KM, Galli SJ. J. Exp. Med. 1992, 175:245-55.

6. Ando A, Martin TR, Galli SJ. J. Clin. Invest. 1993, 92:1639-49.

What is claimed:

1. A method of preventing or treating in a subject contact dermatitis which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat contact dermatitis so as to thereby prevent or treat contact dermatitis in the subject.

2. A method of preventing or treating in a subject hyperpigmentation which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat hyperpigmentation so as to thereby prevent or treat hyperpigmentation in the subject.

3. A method of preventing or treating in a subject asthma which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat asthma so as to thereby prevent or treat asthma in the subject.

4. A method of preventing or treating in a subject cutaneous inflammation which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat cutaneous inflammation so as to thereby prevent or treat cutaneous inflammation in the subject.

5. A method of preventing or treating in a subject anaphylaxis and bronchospasm which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling

pathway effective to prevent or treat anaphylaxis and bronchospasm so as to thereby prevent or treat anaphylaxis and bronchospasm in the subject.

6. A method of preventing or treating in a subject mastocytosis which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat mastocytosis so as to thereby prevent or treat mastocytosis in the subject.

7. A method of preventing or treating in a subject urticaria which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat urticaria so as to thereby prevent or treat urticaria in the subject.

8. A method of preventing or treating in a subject hypersensitivity reactions which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat urticaria so as to thereby prevent or treat urticaria in the subject.

9. A method of preventing or treating in a subject a tumor which expresses activated kit which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat a tumor which expresses activated kit so as to thereby prevent or treat a tumor which expresses activated kit in the subject.

10. The method of claim 9, wherein the tumor is a

gastrointestinal stromal tumor.

11. The method of claim 9, wherein the tumor is a germ cell tumor.

12. The method of any one of claims 1-9, which comprises inhibiting the kinase enzymatic reaction of kit protein.

13. The method of any one of claims 1-9, which comprises inhibiting chymase, elastase or other SCF cleaving enzymes.

14. The method of any one of claims 1-9, which comprises inhibiting ligand binding with an antibody, peptide, or nonpeptide chemical.

15. The method of any one of claims 1-9, which comprises inhibiting kit dimerization with an antibody, peptide, or nonpeptide chemical.

16. The method of any one of claims 1-9, wherein downstream signaling of the kit activation pathway is inhibited by blocking substrate association with kit kinase domain.

17. The method of any one of claims 1-9, wherein downstream signaling of the kit activation pathway is inhibited by blocking enzymatic function in the downstream signaling pathway.

18. The method of any one of claims 1-9, wherein downstream signaling of the kit activation pathway is inhibited by blocking binding of molecules in the downstream signaling pathway.

19. The method of any one of claims 1-9, wherein the

compound is an antibody or portion thereof.

20. The method of claim 19, wherein the antibody is a monoclonal antibody.

21. The method of claim 20, wherein the monoclonal antibody is a human, humanized or a chimeric antibody.

22. The method of claim 20, wherein the monoclonal antibody is an anti-kit antibody.

23. The method of claim 22, wherein the anti-kit antibody is ACK2.

24. The method of any one of claims 1-9, wherein the compound comprises a Fab fragment of an anti-kit antibody.

25. The method of any one of claims 1-9, wherein the compound comprises the variable domain of an anti-kit antibody.

26. The method of any one of claims 1-9, wherein the compound comprises one or more CDR portions of an anti-kit antibody.

27. The method of claim 19, wherein the antibody is selected from the group consisting of IgA, IgD, IgE, IgG and IgM.

28. The method of any one of claims 1-9, wherein the compound comprises a peptide, peptidomimetic, a nucleic acid, or an organic compound with a molecular weight less than 500 Daltons.

29. The method of any one of claims 1-9, wherein the

compound is sSCF, sKIT ligand or a fragment thereof.

30. The method of any one of claims 1-9, wherein the compound is sKIT or a fragment thereof.

31. The method of any one of claims 1-9, wherein the subject is a mammal.

32. The method of claim 31, wherein the mammal is a human being, dog or cat,

33. The method of any one of claims 1-9, wherein the administration is intralesional, intraperitoneal, intramuscular, subcutaneous, intravenous, liposome mediated delivery, transmucosal, intestinal, topical, nasal, oral, anal, ocular or otic delivery.

34. A method of providing contraception to a subject which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent conception so as to thereby provide contraception to the subject.

35. The method of claim 34, wherein the subject is a male subject.

36. The method of claim 34, wherein the subject is a female subject.

37. The method of claim 34, which comprises inhibiting the kinase enzymatic reaction of kit protein.

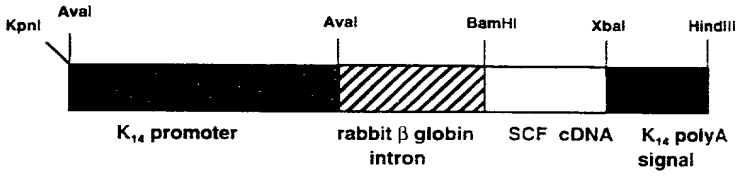
38. The method of claim 34, which comprises inhibiting chymase, elastase or other SCF cleaving enzymes.

METHODS FOR INHIBITING CUTANEOUS INFLAMMATION AND HYPERPIGMENTATION

Abstract of the Disclosure

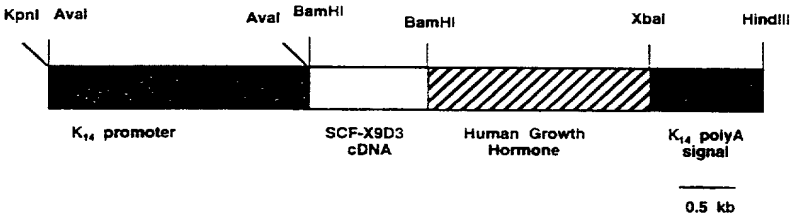
This invention provides a method of preventing or treating in a subject contact dermatitis which comprises administering to the subject an amount of a compound capable of inhibiting the stem cell factor signaling pathway effective to prevent or treat contact dermatitis so as to thereby prevent or treat contact dermatitis in the subject. This invention also provides a methods of preventing or treating in a subject hyperpigmentation, asthma, cutaneous inflammation, anaphylaxis and bronchospasm, mastocytosis, tumors which express activated kit, and conception.

FIG. 1A



TRANSGENE 1

FIG. 1B



TRANSGENE 2

FIG. 2A

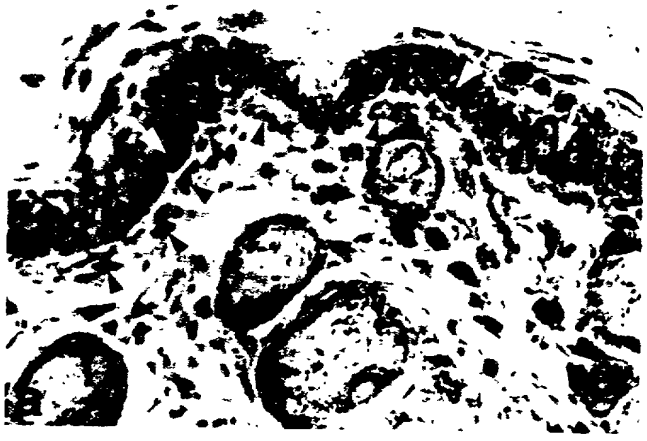


FIG. 2B

FIG. 2C

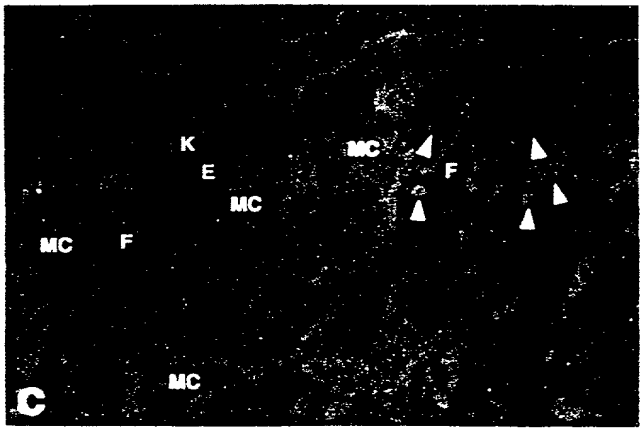


FIG. 2D

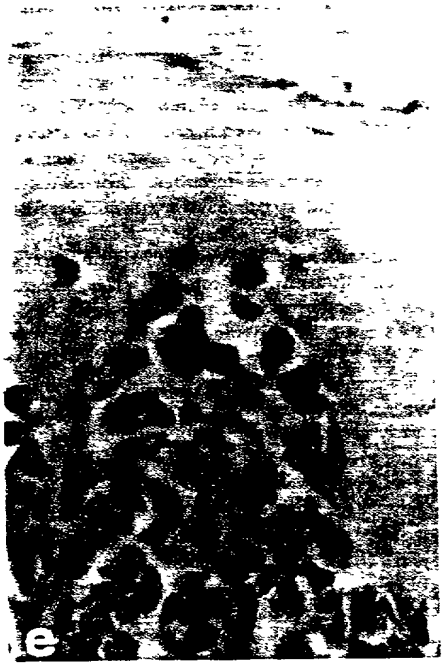


FIG. 2E

FIG. 3A

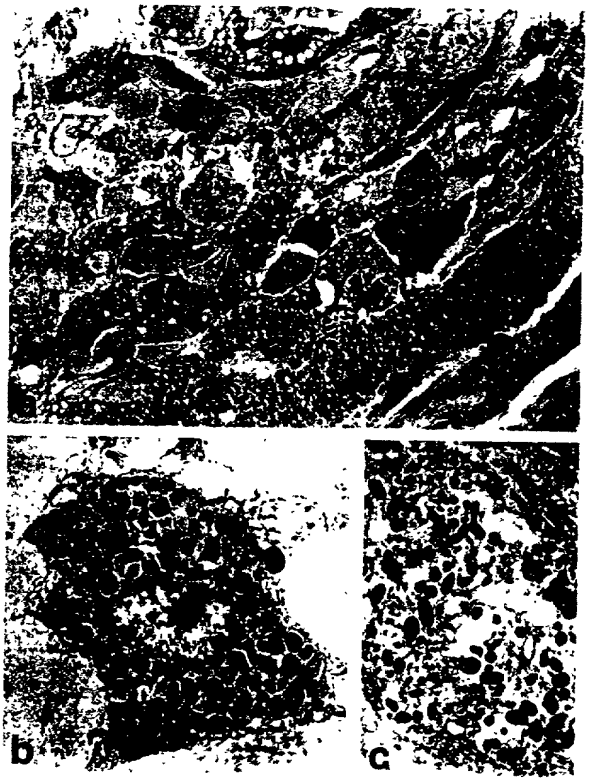


FIG. 3B FIG. 3C

FIG. 4

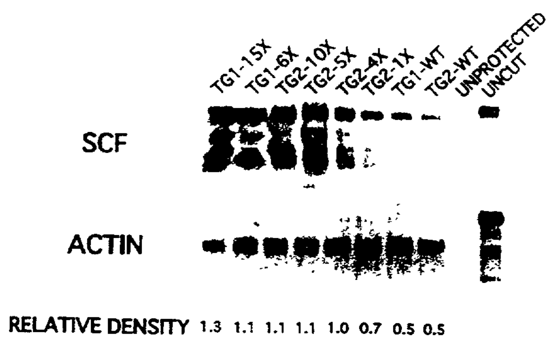

TG1-15X
TG1-6X
TG2-10X
TG2-5X
TG2-4X
TG2-1X
TG1-WT
TG2-WT
UNPROTECTED
UNCUT
SCF
ACTIN
RELATIVE DENSITY 1.3 1.1 1.1 1.1 1.0 0.7 0.5 0.5

FIG. 5A

FIG. 5B

FIG. 5C

FIG. 6A

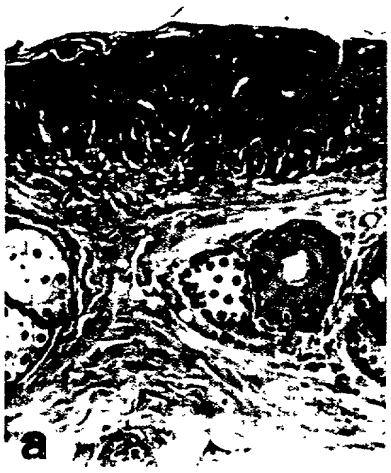


FIG. 6B

FIG. 6C

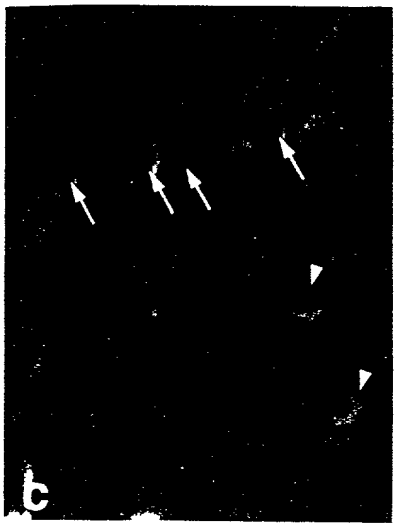


FIG. 7A

FIG. 7B

FIG. 8

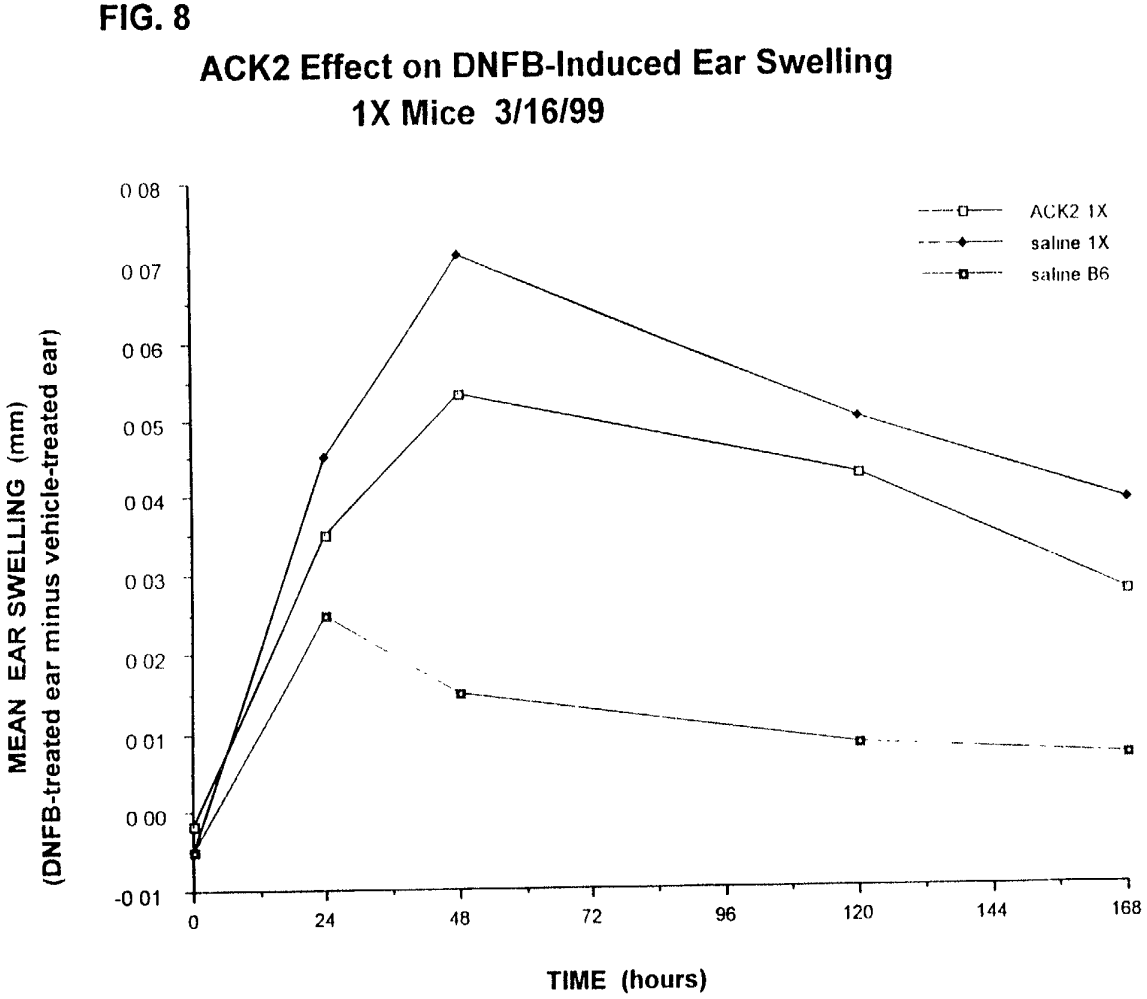

ACK2 Effect on DNFB-Induced Ear Swelling
1X Mice 3/16/99
MEAN EAR SWELLING (mm)
(DNFB-treated ear minus vehicle-treated ear)
0 08
0 07
0 06
0 05
0 04
0 03
0 02
0 01
0 00
-0 01
0
24
48
72
96
120
144
168
TIME (hours)
ACK2 1X
saline 1X
saline B6

FIG. 9A

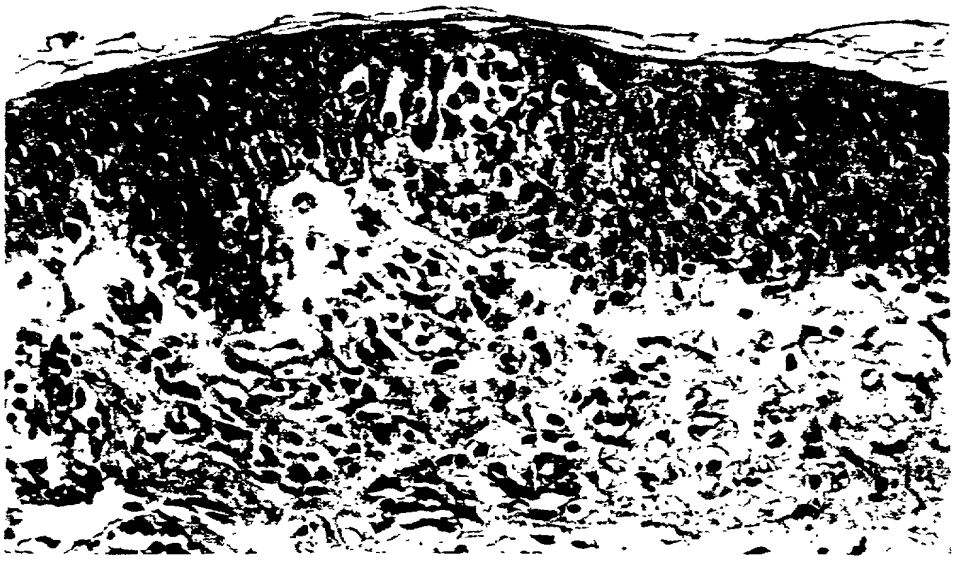
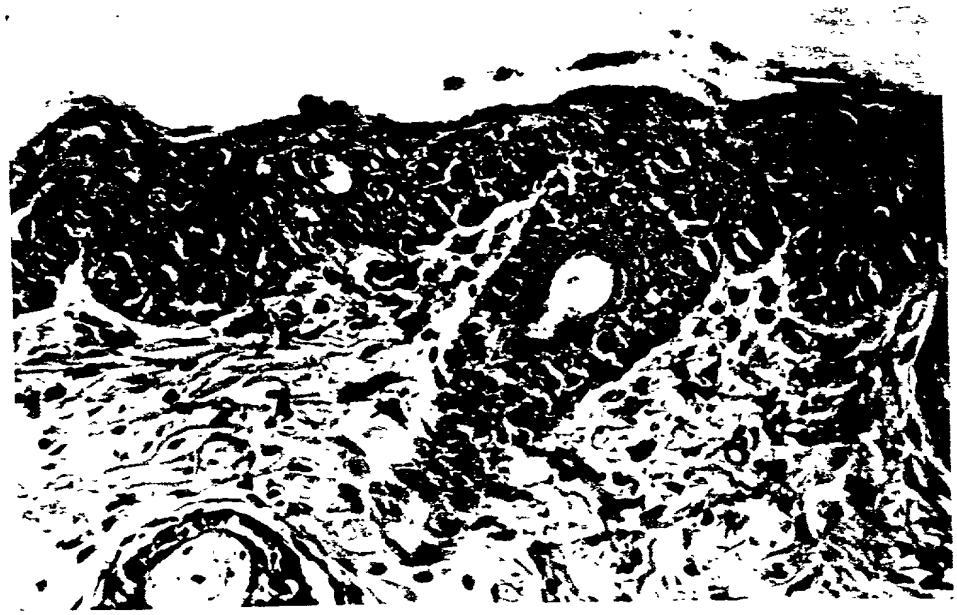


FIG. 9B



58434-A/JPW/SHS

DECLARATION AND POWER OF ATTORNEY

As a below-named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

METHODS FOR INHIBITING CUTANEOUS INFLAMMATION AND HYPERPIGMENTATION

the specification of which:
(check one)

___ *is attached hereto.*

___ *was filed on* _____ *as*

Application Serial No _____

and was amended _____.
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the U.S Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119 (a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International Application which designated at least one country other than the United States, listed below. I have also identified below any foreign application for patent or inventor's certificate, or PCT International Application having a filing date before that of the earliest application from which priority is claimed:

Prior Foreign Application(s)			*Priority Claimed*	
Number	*Country*	*Filing Date*	*Yes*	*No*
N/A			___	___
			___	___
			___	___
			___	___
			___	___
			___	___

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below:

Provisional Application No	*Filing Date*	*Status*
N/A		

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States Application(s), or Section 365(c) of any PCT International Application(s) designating the United States listed below. Insofar as this application discloses and claims subject matter in addition to that disclosed in any such prior Application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56, which became available between the filing date(s) of such prior Application(s) and the national or PCT international filing date of this application:

Application Serial No	*Filing Date*	*Status*
09/306,143	May 6, 1999	Pending

And I hereby appoint

John P. White (Reg. No. 28,678); Christopher C. Dunham (Reg. No. 22,031); Norman H. Zivin (Reg. No. 25,385); Jay H. Maioli (Reg. No. 27, 213); William E. Pelton (Reg. No. 25, 702); Robert D. Katz (Reg. No. 30,141); Peter J. Phillips (Reg. No. 29,691); Wendy E. Miller (Reg. No. 35,615); Richard S. Milner (Reg. No. 33, 970); Robert T. Maldonado (Reg. No. 38,232); Paul Teng (40,837); Gary J. Gershik (Reg. No. 39,992); Richard F. Jaworski (Reg. No. 33, 515); Elizabeth M. Wiechowski (Reg. No,. 42, 226); and Pedro C. Fernandez (Reg. No. 41, 741)

and each of them, all c/o Cooper & Dunham LLP, 1185 Avenue of the Americas, New York, New York 10036, my attorneys, each with full power of substitution and revocation, to prosecute this application, to make alterations and amendments therein, to receive the patent, to transact all business in the Patent and Trademark Office connected therewith and to file any International Applications which are based thereon under the provisions of the Patent Cooperation Treaty.

Please address all communications, and direct all telephone calls, regarding this application to:

John P. White *Reg No.* 28,678

Cooper & Dunham LLP
1185 Avenue of the Americas
New York, New York 10036
Tel. (212) 278-0400

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first joint inventor B. Jack Longley

Inventor's signature _____

Citizenship United States of America *Date of signature* _____

Residence 49 Woodstock Road, Hamden, CT 06517

Post Office Address same as above

_____

Full name of joint inventor (if any) _____

Inventor's signature _____

Citizenship _____ *Date of signature* _____

Residence _____

Post Office Address _____

_____

Full name of joint inventor (if any) _____

Inventor's signature _____

Citizenship _____ *Date of signature* _____

Residence _____

Post Office Address _____

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